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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/782,874	02/23/2004	Wen Yu	50432-646	7092

7590 12/02/2004  
McDERMOTT, WILL & EMERY  
600 13th Street, N.W.  
Washington, DC 20005-3096

EXAMINER
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BREWSTER, WILLIAM M

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 12/02/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/782,874

Applicant(s)

YU ET AL.

Examiner

William M. Brewster

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 30 July 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-19 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>073004</u> . | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Claim Objections***

Claim 1 is objected to because of the following informalities: claim 1, line 5, states a "contact hold". Appropriate correction is required.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-9, 11, 14-16 are rejected under 35 U.S.C. 102(e) as being anticipated by Zhang et al., US Publication No. 2003/00728884 A1.

Zhang anticipates a method of forming a contact in a semiconductor device, comprising the steps:

in fig. 2A, forming a silicon substrate 200 with a conductive region, below 204;

forming a dielectric layer 202 on the silicon substrate and a contact hole in the dielectric layer exposing at least a portion of the conductive region, p. 2, ¶ 32-33;

depositing a refractory metal 204 contact layer in the contact hold and on the conductive region portion;

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forming a silicide region by reacting the refractory metal contact layer with the conductive region portion, p. 3, ¶ 36;

in fig. 2B, forming a contact barrier metal layer 208 on the refractory metal contact layer; without plasma treatment, p. 3, ¶ 38; and plasma treating the contact barrier metal layer only after the forming of the silicide region, p. 3, ¶ 40;

limitations from claims 2, 16, the method, wherein the refractory metal contact layer consists of titanium (Ti), p. 3, ¶ 33;

limitations from claim 3, 16, the method, wherein the contact barrier metal layer consists of titanium nitride (TiN), p. 3, ¶ 40;

limitations from claim 4, the method, wherein the step of depositing a refractory metal contact layer and the step of forming a silicide region includes depositing the titanium at a temperature sufficient to cause the titanium to react with the conductive region portion to form silicide at the conductive region portion, p. 3, ¶ 36;

limitations from claims 5, 6, the method, wherein the temperature is above 500 °C, or above 600° C, p. 3, ¶ 33;

limitations from claim 7, the method, wherein the step of forming a silicide region includes performing an in-situ anneal at a temperature sufficient to cause the titanium to react with the conductive region portion to form silicide at the conductive region portion, p. 3, ¶ 33-36;

limitations from claims 8, 9, the method, wherein the temperature is above 500 °C, or above 600° C, p. 3, ¶ 33-36;

limitations from claim 11, the method, wherein the step of depositing a refractory metal contact layer includes physical vapor deposition of the refractory metal contact layer, p. 4, ¶ 48;

limitations from claim 14, the method, wherein the step of forming a contact barrier metal layer is performed after the step of forming a silicide region and before the step of plasma treating the contact barrier metal layer, p. 3, ¶ 40;

limitations from claim 18, the method, wherein the depositing of the refractory metal contact layer and the forming of silicide at the contact region are performed simultaneously by depositing the refractory metal contact layer at a temperature sufficient to cause the titanium to react with the contact region, p. 3, ¶ 33, 36;

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 10, 12, 13, 17, 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang as applied to claims 1-9, 11, 14-16 above, and further in view of Huang, US Publication No. 2003/0194859, from the IDS.

Zhang does not specify forming a barrier layer prior to forming a silicide region, but Huang does. Huang teaches in fig. 1 forming a substrate 100, a contact region 102, in fig. 2, forming a contact hole 108, limitations from claim 12, the method, in fig. 3,

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wherein the step of forming a contact barrier metal layer includes metal organic chemical vapor deposition (MOCVD) of the contact barrier metal layer, p. 3, ¶ 27; limitations from claim 13, the method, wherein the step of forming a contact barrier metal layer is performed prior to the step of forming a silicide region, p. 3, ¶ 29; limitations from claim 19, the method, in fig. 5, wherein the method of forming silicide 116 includes in-situ annealing after the depositing of the refractory metal contact layer, at an annealing temperature sufficient to cause the titanium to react with the contact region, p. 3, ¶ 29. It would have been obvious to a person of ordinary skill in the art at the time the invention was made to recognize that combining Huang's invention with Zhang's invention would have been beneficial because Zhang gives motivation on pp. 1-2, ¶ 14-16. It would have been obvious to a person of ordinary skill in the art at the time the invention was made to recognize that combining Zhang's invention with Huang's invention would have been beneficial because it helps reduce or eliminate cracking and fracturing of the barrier material.

For claim 10, neither Huang nor Zhang specify the relative thickness of the contact layer or the silicide layer, formed by reacting the refractory metal contact layer with the conductive region portion. However, these dimensions may be optimized.

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art . . . such ranges are termed 'critical

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ranges' and the applicant has the burden of proving such criticality . . . More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

In re Aller 105 USPQ 233, 255 (CCPA 1955). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmischer 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to William M. Brewster whose telephone number is 571-272-1854. The examiner can normally be reached on Full Time.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

*William M. Brewster*

24 November 2004

WB